

*Sub A1*  
**Claims:**

- 1                   1. A method of enhancing the signal-to-noise ratio of a microphone  
2 array, the array including a plurality of microphones and having a directivity pattern,  
3 the directivity pattern of the array being adjustable based on one or more parameters,  
4 the method comprising the steps of:  
  
5       a. evaluating one or more parameters to realize an angular orientation of a  
6       directivity pattern null, which angular orientation reduces microphone array  
7       output signal level, said evaluation performed under a constraint that the null  
8       be located within a predetermined region of space;  
  
9       b. modifying output signals of one or more microphones of the array based on  
10      the one or more evaluated parameters; and  
  
11      c. forming an array output signal based on one or more modified output signals  
12      and zero or more unmodified microphone output signals.

- 1                   2. The method of claim 1 wherein steps a, b, and c, are performed a  
2 plurality of times to obtain an adaptive array response.

- Sub A2*  
1                   3. The method of claim 1 wherein the predetermined region of space  
2 includes sources of undesired acoustic energy.

- 1                   4. The method of claim 1 wherein undesired acoustic energy impinges on  
2 the array from a direction within the predetermined region of space.

- 1                   5. The method of claim 1 wherein the array has a plurality of directivity  
2 patterns corresponding to a plurality of frequency subbands, one or more of the  
3 plurality of directivity patterns including a null.

1                6. The method of claim 5 further comprising the step of forming a  
2 plurality of subband microphone output signals based on an output signal of a  
3 microphone of the array, wherein the step of modifying output signals comprises  
4 modifying the subband microphone output signals based on the one or more  
5 evaluated parameters.

1                7. The method of claim 1 wherein the array comprises a plurality of  
2 cardioid sensors.

1                8. The method of claim 7 wherein the plurality of cardioid sensors  
2 comprises a foreground cardioid sensor and a background cardioid sensor and  
3 wherein the step of evaluating comprises determining a parameter reflecting a ratio  
4 of (i) a product of output signals of the foreground and background cardioid sensors  
5 to (ii) the square of the output signal of the background cardioid sensor.

1                9. The method of claim 7 wherein the plurality of cardioid sensors  
2 comprises a foreground cardioid sensor and a background cardioid sensor and  
3 wherein the step of evaluating comprises determining a scale factor for an output  
4 signal of the background cardioid sensor.

1                10. The method of claim 9 wherein the scale factor is determined based  
2 on an output signal of the background cardioid sensor and the array output signal.

Sub  
A3  
1                    11. An apparatus for enhancing the signal-to-noise ratio of a microphone  
2 array, the array including a plurality of microphones and having a directivity pattern,  
3 the directivity pattern of the array being adjustable based on one or more parameters,  
4 the apparatus comprising:

- 5     a. means for evaluating one or more parameters to realize an angular orientation  
6       of a directivity pattern null, which angular orientation reduces microphone  
7       array output signal level, said evaluation performed under a constraint that the  
8       null be located within a predetermined region of space;
- 9     b. means for modifying output signals of one or more microphones of the array  
10       based on the one or more evaluated parameters; and
- 11    c. means for forming an array output signal based on one or more modified  
12       output signals and zero or more unmodified microphone output signals.

1                    12. The apparatus of claim 11 wherein the predetermined region of space  
2 includes sources of undesired acoustic energy.

1                    13. The apparatus of claim 11 wherein undesired acoustic energy  
2 impinges on the array from a direction within the predetermined region of space.

1                    14. The apparatus of claim 11 wherein the array has a plurality of  
2 directivity patterns corresponding to a plurality of frequency subbands, one or more  
3 of the plurality of directivity patterns including a null.

1                    15. The apparatus of claim 14 further comprising means for forming a  
2 plurality of subband microphone output signals based on an output signal of a  
3 microphone of the array, wherein the means for modifying output signals comprises  
4 means for modifying the subband microphone output signals based on the one or  
5 more evaluated parameters.

1                   **16.** The apparatus of claim 14 wherein the means for evaluating  
2 comprises a polyphase filterbank.

1                   **17.** The apparatus of claim 11 wherein the means for modifying  
2 comprises a means for performing fast convolution.

1                   **18.** The apparatus of claim 11 wherein the array comprises a plurality of  
2 cardioid sensors.

1                   **19.** The apparatus of claim 18 wherein the plurality of cardioid sensors  
2 comprises a foreground cardioid sensor and a background cardioid sensor and  
3 wherein the means for evaluating comprises means for determining a parameter  
4 reflecting a ratio of a (i) product of output signals of the foreground and background  
5 cardioid sensors to (ii) the square of the output signal of the background cardioid  
6 sensor.

1                   **20.** The apparatus of claim 18 wherein the plurality of cardioid sensors  
2 comprises a foreground cardioid sensor and a background cardioid sensor and  
3 wherein the means for evaluating comprises means for determining a scale factor for  
4 an output signal of the background cardioid sensor.

1                   **21.** The apparatus of claim 18 wherein the scale factor is determined  
2 based on an output signal of the background cardioid sensor and the array output  
3 signal.

1                   **22.** The apparatus of claim 11 wherein the array comprises a cardioid  
2 sensor and a dipole sensor.

- 1                    23. The apparatus of claim 11 wherein the array comprises a  
2 omnidirectional sensor and a dipole sensor.